the perusal of any scientist, no matter in what direction his interests may be enlisted.

Following this are chapters on the differentiation of simple functions; integral calculus and its applications; higher differential equations and the functions of variables; infinite series and Taylor's series; the theory of maxima and minima; solution of numerical equations; examples from mechanics and thermo-dynamics. Collections of problems and formulæ precede the index, which completes the volume.

The aim of this book is fully expressed by its title; its scope is indicated by the above summary of its contents.

Although not a pioneer in this particular field—A. Fuhrmann's Naturwissenschaftliche Anwendungen der Differential-rechnung was published in 1888, the appearance of this treatise must be pronounced most opportune. It is certainly deserving of a cordial welcome, and mastery of its contents can not fail to be of great value to all who have not already appreciated the important bearing of the higher mathematics on numerous problems of natural science.

FERDINAND G. WIECHMANN.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON—257TH MEETING, SATURDAY, MARCH 7.

A PAPER on *the Influence of Fruit-bearing upon the Mechanical Tissue of the Twigs*, by Adrian J. Pieters, was, in the absence of the author, read by George H. Hicks. The author's conclusions, based on a study of twigs of the apple, pear, peach and plum were that the one-year-old fruit-bearing shoot of the apple and the pear has less wood in proportion to its diameter than does the vegetative shoot of the same age. This is due, in the apple largely, and in the pear solely, to a great increase in the cortex of the fruit-bearing shoot. It does not, however, appear from the structure of the shoots that the fruit-bearing shoot is weaker than the vegetative. The former is well supplied with supplementary mechanical tissue which is distributed at those points where it is most needed. This gives an increase of strength for the fruit-bearing year, which fully makes up for the small difference in xylem. In the peach the fruit-bearing shoot has more wood than the vegetative, and the walls of the wood cells are as thick in the former as in the latter.

In general it may be said that the effect of fruit-bearing upon the tissues is local. In the apple and pear it is felt throughout the one-year-old shoot; in the plum and peach it is confined to a small area in the immediate neighborhood of the fruit stalk.

The local effect on fruit-bearing is towards an increase of cells and a decrease in the thickness and lignification of the walls of the wood cells. The cortex is especially enlarged, giving rise in the apple and pear to the characteristic swollen condition of the fruit-bearing shoot.

In all cases the increase in growth is greatest on the side near the fruit stalk, although the wood in the apple and pear is best developed on the side of the lateral vegetative bud.

The effect which fruit-bearing exerts upon the xylem disappears with time. The study of apple shoots that had borne fruit in their first year showed that in the two or four years following there had been a rapid increase of wood, especially on the side of the fruit scar which was weakest at the end of the first year. At the end of three and five years these shoots had a better xylem development than shoots of the same age that had never borne fruit.

Fruit-bearing has a local effect upon the lignification of the walls of wood cells. It prevents their lignification wholly or in part according to their distance from the fruit stalk.

The lignification of other cell walls is promoted by fruit-bearing. In the fruit stalk the greatest part of the tissue has become lignified, and in the upper part of the apple and pear shoots there is an abundance of sclerenchyma and hard bast, which is either not found in the vegetative shoots or only in small amounts.

Dr. E. L. Greene presented a paper on *The Distribution of Rhamnus and Ceanothus in America.* Of the first named genus, the European *Rhamnus cathartica* being its type-species, some 100 species are recognized, these being distributed all around the northern hemisphere, chiefly within the temperate zone. In contrast with Europe, which has 23, North America north of

Mexico is poor in species, not more than 12 or 14 being credited to our territory. Four of these are of the Atlantic slope of the continent, the rest belonging exclusively to the Pacific slope. That narrow strip of territory intervening between the crest of the Sierra Nevada and the Pacific has more than twice the number of Rhamnus species exhibited by all the vast area of the United States besides. Each one of the far-western species occupies an altitudinal belt of its own, never trespassing upon the territory of another species; *R. Californica*, for example, inhabiting the Coast Range hills, from near the level of the sea up to an elevation of several hundred feet. In the dry interior region lying between the two mountain chains, *R. tomentella* holds the field as exclusively, this at altitudes varying from 300 to 3000 feet. Then, after passing the region of this shrub of the dry interior, and reaching an altitude of about 5,000 feet, where there is deep annual snowfall, there occurs a narrow belt of an exceedingly distinct species, *R. rubra*; this shrub being deciduous, while both its allies of the lower altitudes are evergreen.

Ceanothus, the genus of shrubs, most nearly allied to *Rhamnus*, instead of being like that, almost cosmopolitan, is confined to North America; where only 4 out of the whole number of more than 60 sorts are of the Atlantic slope; some 6 belong to Mexico and Arizona; all the remaining 50 occurring within the limits of the State of California; no fewer than 40 of them being strictly limited to that State, where the Coast Range seems to be the special home of the genus.

The two eastern species, *C. Americanus* and *C. ovatus*, which are the type of the genus, have but one near ally, and that is the far-western *C. sanguineus*. The two Floridan species, *C. microphyllus* and *C. serpyllifolius* are in affinity far removed from the other Atlantic species, and are separated from their only near relatives, certain species of the Californian Coast Range, by a distance of more than 2,000 miles. Again, one species peculiar to islands near the California coast is related to none of the species of the closely adjacent mainland, but has its near kindred more than 1,000 miles southward, in central Mexico.

Frederick V. Coville spoke of *Different Editions of Some Government Expedition Reports*, stating that several editions of the reports of the expeditions of Emory, Stansbury and Fremont had been published, and that not only were there differences in the pagination, but, in some instances, changes in the text, these alterations in some cases affecting the specific and even generic names of plants. Anyone quoting from these reports, the speaker said, should be careful to state exactly which edition was referred to.

F. A. LUCAS,
Secretary.

THE WOMAN'S ANTHROPOLOGICAL SOCIETY.

THE 140th meeting of the Society was held February 29th, the day being devoted to Archæology. Miss Sarah A. Scull gave a talk on the growth of Art in Egypt, Chaldea, Assyria and Greece, and comparisons were drawn between Semitic and Aryan arts. All sections of the Society, in their studies, are looking especially towards this point—differences in the two families, Semitic and Aryan—and many interesting comparisons have been drawn in the section meetings as well as in those meetings that have been open to the public. Miss Scull's remarks were illustrated by stereopticon views, many of which were from photographs taken by herself.

The meeting of March 14th was in charge of the section for Child-Life study. Mrs. Eudora Lucas Hailmann, who has devoted her life to study of the child in the Kindergarten, presented her views on the use of symbols in early education. In the treatment of the subject, the address had reference entirely to children of the age from three to seven inclusive. Normal, vigorous children of these ages do not speculate, do not dream day dreams, do not see sprites in the flowers, nor ogres in the forest, unless they have been put there by older heads. Their eager, active, healthy minds and bodies are too much absorbed in the immediate interesting beautiful wonders that surround them. There is no need to stimulate their love and admiration for life by artificial means, and they have not reached the contemplative, speculative age of abstract thinking. To force

this upon them at this period of development is to make them precocious, and consequently, to arrest development and to rush them into degeneracy. The child, if left to himself, will discover symbolism in nature. When it is given to him ready made it has a tendency to render him superstitious, credulous and superficial. During these specially sensitive years of early childhood impressions should be pure, clear, direct and complete. The brain, at this period, is more susceptible and much more active, consequently much more intensely conscious, that in later life, eagerly clinching every new impression in order to make use of it in giving expression to its own individuality, which has become firmly rooted in the loves and lives of its environment. The thought centers for this period should be full of instruction and abound in beautiful sentiment.

There is current a doctrine that in each child there are repeated the various phases of development in the life of humanity. It should be remembered, however, that the earlier stages of development, through which the child must pass, are meant, by the very laws of evolution, to sink into rudimentary conditions. To emphasize them must result in arrested development and retard the progress of the race. Education should treat them in such a way as to reduce to a minimum their influence in the life of the child and to assist him to use all his strength in living intelligently toward the ideals of the race. The crudities and superstitions transmitted to us in the myths and allegories of past ages can stimulate only crudity and superstition in the minds of little children whose mental development is not sufficient to enable them to see and appreciate their latent truth and beauty. To force such myths and allegories upon children at too early an age will, on the one hand, subject them in later years to painful struggles to overcome morbid tendencies, and, on the other hand, will blunt their sensibilities to the truth, beauty and love in their environment. Moreover, when persons tell such myths and allegories to little children they labor to adapt them to the children's understanding, in what they call simpler language, and mar both the story and the child.

A. CARMAN,
Secretary.

THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, PA., FEBRUARY 10, 1896.

A paper entitled 'Summary of New Liberian Polydesmoidea,' by O. F. COOK, was presented for publication.

General Isaac J. Wistar called attention to the apparently capricious distribution of iron oxide as coloring matter in the rocks of the anthracite coal region. A section in Lykens Valley, for example, shows a thick stratum of red shale below the carboniferous series. It is overlaid by thin green sandstones, the color of which is due to another oxide of the same metal. Upon this rests the thick masses of the Pottsville conglomerate, a white quartzite which shows no coloration from iron, except perhaps a slight external tinge on the enclosed quartz pebbles. Above the conglomerate we find intercalated among the sand stones of the coal measures sixteen coal seams of varying thickness, of which the lowest three show a red ash, several below them a white ash, while the upper three return to a red or pink ash. Above the coal measures there are no signs of iron coloration until, in other localities, the Trias is reached, when we find the red coloring as pronounced as in the carboniferous shales.

These several strata cover a long period in geological history and exhibit the following phenomena: During the red shale period the presence of iron oxide was sufficient to give a high color to the entire deposits. During the still longer period of the conglomerate the available iron, having been all distributed in the red shale, did not appear at all and the conglomerate beds show none. In the deposit of the three lowest seams a fresh supply of iron appears, enough to color their mineral constituents red. Then ensued a long series of coal seams containing little or no iron, to be followed by several red-ash seams near the top of the series. There is then an entire absence of iron in sufficient quantity to color the rocks, until, when the Triassic period occurs, evidences of the universal distribution of iron oxide are more abundant than ever.

These facts appear to show several points during which the accessible supply of iron was exhausted by complete distribution in the strata

under process of deposit, with intermediate and subsequent periods during which new supplies appear from some source not yet clearly explained.

Prof. Amos Peaslee Brown stated that it had been suggested by Russell that the red color of certain formations may have originated from the subaërial decay of iron-bearing rocks and the subsequent deposit of this material as sediment forming the red rock. Such rocks as contain iron, especially limestone and the metamorphic schists, would weather in the atmosphere to reddish clays, and during periods when denudation of the surface was not active, or when the land remained at constant level, such weathered accumulations could form to considerable depths. A rise of land level would cause denudation of this accumulated red soil and result in deposit elsewhere. The periods preceding the formation of the Mauch Chunk red shale and the New Red or Trias were such periods of quiescence and they were followed, in the first case locally and in the second generally, by elevation of land causing denudation to be set up and accumulation of red clays to be formed.

So far as the ash of coal is concerned, it is probable that the color is due to the way in which pyrite is contained either in the coal itself or in the slates adjoining. Coal containing separable pyrite would give white ash, while if the pyrite is intimately mixed in the coal the ash will be red.

The subject was further discussed by Messrs. Heilprin, Willcox, Goldsmith and Lyman.

Mr. Jos. Willcox and Prof. Angelo Heilprin commented on the evolutionary value of the large collection of Fulgurs presented at the last meeting, the former claiming that about twenty-five species had been reduced, by the presence of complete series of intermediate forms, to three or four.

EDW. J. NOLAN,
Secretary.

NEW YORK SECTION OF THE CHEMICAL SOCIETY, MARCH 6, 1896.

THE papers presented were:

The Cassel-Hinman Gold and Bromin Process: P. C. MCILHINEY.

The Specific Gravity of Glue Solutions: E. R. HEWITT.

Investigations in the Chemistry of Nutrition: W. O. ATWATER.

Mr. McIlhiney enumerated the advantages of bromin over chlorine in the gold extraction process, as (a) greater solubility in water of bromin, 3.2 per cent. against 0.76 per cent. of chlorine; (b) lesser oxidizing power, whereby the iron pyrites is less acted upon; (c) greater solvent power of bromin for gold.

The bromin is recovered by distillation with live steam in stone tanks, after addition of sulphuric acid and an oxidizing agent, as permanganate of potash.

The process is especially adapted to the treatment of low grade telluride ores which have not hitherto been profitably worked.

Mr. Hewitt in his work on specific gravity of glue solutions had obtained his results from experiments on twelve different grades of glue, from the best photographic gelatine to the darkest and poorest grades in the market. He finds the expansion of glue solutions to be the same as water alone; that the specific gravity of glue containing moisture is less than of glue in the dry state; that the hydrometer could not be used in solutions containing over 65 per cent. glue, and that the specific gravity is independent of the quality of the glue.

He concludes that there is a series of distinct chemical combinations of glue with water.

Dr. Atwater described the recent work under his direction at Middletown, Conn., in determining the heats of combustion or fuel values of foods. He said that 'we know the laws of the conservation of energy hold good in the living organism, but we do not yet know *how* they held good. We must study these things in the living organism, and for this purpose a 'respiratory calorimeter' has been constructed of copper, large enough for a man to remain in for some time, and by which the experimental determination of heat of radiation, energy of food consumed, etc., is to be carried out.'

Experiments lasting four days had recently been made, and it was expected to arrange to keep a man in the apparatus by the week.

Eight attendants were required to conduct these experiments, four by day and four by

night, keeping temperature records, weighing the food, making analyses, etc.

In reply to questions as to effect of food on the quality of the fat, Dr. Atwater stated that experiments made on dogs had conclusively proved that the fat formation is a function of both the organism and the food.

DURAND WOODMAN,
Secretary.

GEOLOGICAL CONFERENCE OF HARVARD UNIVERSITY, FEBRUARY 18, 1896.

1. *An Occurrence of Theralite in Costa Rica.* By J. E. WOLFF. To be published in Amer. Jour. Sci., April, 1896.
2. *The Harvard Meteorological Stations in Peru.* By R. DEC. WARD.

In 1887 a considerable sum of money was left to Harvard College Observatory by the will of Mr. Uriah A. Boyden, to aid in the establishment of an observatory "at such an elevation as to be free, so far as practicable, from the impediments to accurate observations which occur in the observatories now existing, owing to atmospheric influences." In order to select the best possible location for the new observatory, expeditions were undertaken, in 1888 and 1889, to Colorado and California, where astronomical work of various kinds was done at a number of different places. None of the stations thus temporarily occupied proved entirely satisfactory, and it was finally decided to establish the new station in Peru, where Messrs. S. I. and M. H. Bailey had, in the mean time, obtained some excellent results in connection with astronomical work done by them for the Harvard College Observatory on Mt. Harvard, in Peru. The expedition which was sent out to build the new observatory left the United States, under the direction of Prof. Wm. H. Pickering, in December, 1890, arriving at its destination the middle of the following January.

The meteorological advantages for astronomical work in the region selected for occupation are very great. The temperature seldom falls below 40° and seldom rises above 75°. The rainy season is very short, and but little rain falls, generally less than four inches. November marks the beginning of the cloudy season; December is fairly clear, and January to March are cloudy and rainy. During the rest of the year the atmosphere is very dry, and the sky prevailingly clear. In the rainy season it by no means rains every day, there being often a week or a fortnight during which no rain falls. The excessive dryness of the climate, in which vegetation is maintained only by constant irrigation, the short rainy season and the small amount of cloudiness combine to make this a most favorable region for astronomical work.

There are at present eight meteorological stations in Peru, maintained by the Harvard College Observatory. The principal one is at Arequipa, where the observatory is situated at an altitude of 8,050 feet above the sea, and about 80 miles from the coast. The city itself is situated in a little oasis formed by a river valley at the foot of the Cordillera, a little above the lower-lying desert. At Mollendo, on the seacoast, there is a meteorological station 85 feet above sea level. Between Mollendo and the main station at Arequipa, another station has been established, at La Joya, about in the center of a rainless, barren region, and at an elevation of 4,140 feet. The most interesting station of all is that on the summit of the volcano El Misti, 19,200 feet above the sea, lying northeast of Arequipa, about ten miles distant. This station, established after much hardship and maintained with considerable difficulty, is now the highest meteorological station in the world. Mr. S. P. Fergusson, of Blue Hill Observatory, Massachusetts, has recently constructed a meteorograph for the Misti, which records automatically temperature, pressure, humidity, and wind direction and velocity, and will run three months without rewinding. This instrument will obviate the necessity of the frequent visits now made to the summit by the observers at Arequipa.

The other stations are as follows: Flank of El Misti, 15,700 feet, about the altitude of Mont Blanc; Alto de los Huesos, 13,400 feet, a high desert plateau east of El Misti; Cuzco, between the eastern and western Andes, 16,100 feet, and Santa Ana, east of the Andes, in the Urubamba Valley, 3,400 feet above the sea.

This continuous line of stations, reaching from the coast inland over 350 miles, and including such great altitudes as the summit and flank of

El Misti, is equalled nowhere else in the world, and the results which the data there collected will furnish are certain to be of the greatest importance to meteorology.

MARCH 3, 1896.

Geography and Geology for Training and Elementary Schools. By R. E. DODGE.

A teacher in a training school for teachers has before him a double task, especially if his subject be one that can also be taught to the children. The teacher of geography and geology has such a specialty, and hence the requirements upon his abilities are somewhat general and diversified. He must, on the one hand, give to the students preparing under his guidance to become teachers, such a scientific understanding of the principles of the sciences that they can go out into active teaching well equipped for their work. On the other hand, he must see that the children in the elementary schools, which are now usually attached to training schools for purposes of observation and practice by the would-be teachers, are given the principles of geography and geology in a way that best illustrates the principles of matter and method he is presenting to his students. In both cases he should recognize that the matter presented should be scientifically treated and scientifically accurate, the method of presentation varying so as always to be adapted to the minds of the pupils.

The would-be teachers must, from the usual inadequacy of their previous training, be well drilled in the principles of the sciences before they are given conceptions of the methods of adapting the matter of the sciences to the younger children. The scientific spirit of interest and inquiry and of rational imagination should be developed as strongly as possible, that the teacher may impart such a spirit to the pupils under her, no matter what their age.

Inasmuch as geography is the most important of all the sciences to be taught in the schools, the teacher should be given only so much geology as would make her best understand the principles of geography. The treatment of geography should give the facts, related in a rational and scientific way, so that she gains not only matter, but the ability to adapt to her own needs any matter that she may be called upon to use.

A teacher thus equipped scientifically, so that she understand the underlying principles of geography, physical, political, descriptive and commercial, can adapt herself to the conditions she meets, so as to become more than a repeater of the matter contained in text-books. Text-books then become, as they should be, suggestive sources rather than complete repositories of matter.

If the principles of geography are presented to the children in the same scientific way, so as to arouse them to observation and investigation, their interest is at once increased, the whole science becomes alive to them, and they are eager to go on and to learn more.

A course in geography for schools should be graded, scientific, and framed so as to impart an understanding of and a love for nature. It should begin with a conception of the processes shown in the daily and seasonable changes about the home. With that as a basis, the child can be lead to an understanding of the other parts of the world, both similar and dissimilar, and becomes more appreciative of the form and meaning of the earth's features. By building little by little upon such a beginning, the pupil can, in the eight years previous to the high school, gain a conception of the relation of man to the geographic features, such as can be rarely if ever given by the method of teaching geography as something to be memorized.

In a course that includes geography, in its many aspects, botany, zoölogy and meteorology, it is possible to give the child a large amount of locative and descriptive geography, and an understanding of the reasons for the customs, habits and development of the great nations; for the routes of commerce and explorations, etc., etc. In this way the child gains an understanding of the world and an ability to interpret the world for himself, that will be of great service to him even after he has forgotten many of the details that he may have memorized. He gets an ability to make use of his powers in adapting himself to new conditions, such as he could never get were the science only taught as a subject for memorizing and not for reasoning.

In the whole course for teachers, if the matter, method and the scientific spirit be kept in mind, the teachers go to their work with a liking for it which is not gained otherwise. A course in geography for teachers and children along the lines suggested above has been planned and is now in operation in the Teachers' College, New York City, and though it is in its first year of operation the result is very pleasing, and the promise for future good results is most encouraging. The constantly increasing interest, as well as understanding, of the children shows that the conception that physical geography can not be profitably given to young children, is erroneous. If it is given in a way to arouse them to thought it becomes a means of drill that is of great service, and that develops more of their powers than if they were simply required to do a lot of memorizing of description and location, without any scientific underlying thread connecting the various topics considered.

Experiments imitative of Glacial Esker and Sand-Plain Formation. By C. W. DORSEY.

A preliminary account was given of a series of experiments performed under the direction of Mr. T. A. Jaggar in the Laboratory of Experimental Geology. The object of the experiments is to reproduce in miniature the conditions of delta deposition at the mouth of a subglacial cavern, with a view to systematic study of the conditions that govern the form of deltas, the arrangement of bedding in cross-section, the development of lobate margins and the influence of variations in stream velocity, coarseness of material and water level. The apparatus used consists of a tin half-tube whose cross-section has the form of an inverted U, and this is longitudinally bent into somewhat serpentine form, to imitate a subglacial stream cavern; a funnel soldered at its upper end supplies load, and a rubber tube from the hydrant supplies the current. Thin sheet lead is bent over this apparatus to represent roughly the form of a glacier front, and the whole is arranged in a large square tank. On starting the current, sand, fine gravel and mixtures of sand with plaster are fed into the funnel and are deposited in a fan delta at the cavern's mouth. The structures obtained may be photographed at any stage, and at the end of each experiment the imitation cavern is removed to show the deposit that represents the feeding esker. On slicing the deltas horizontally and vertically the progressive stages of growth are beautifully shown by the white plaster layers, and in this way migration of the lobes and of the frontal scarp of the delta, as well as the arrangement of cross-bedding, back-set beds, etc., may be traced. An attempt with ice is in preparation, to test the effect of the melting away of the ice on the resultant forms.

The results of these experiments will be offered for publication in the near future, probably in the Journal of Geology.

T. A. JAGGAR, JR.,
Recording Secretary.

NEW BOOKS.

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Grundriss der Krystallographie. DR. GOTTLOB LENCK. Jena, Gustav Fischer. 1896. Pp. vi+252. M. 9.

Elements of Botany. J. Y. BERGEN. Boston and London, Ginn & Co. 1896. Pp. v+57.

Voice Building and Tone Placing. HOLBROOK CURTIS. New York, D. Appleton & Co. 1896. Pp. xii+215. $2.00.

The Whence and Whither of Man. JOHN M. TYLER. New York, Charles Scribner's Sons. 1896. Pp. xv+312. $1.75.

The Dynamo. S. R. BOTTONE. London, Swan, Sonnenschein & Co., Lim.; New York, Macmillan & Co. Pp. 116. 90 cents.

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Experiments in General Chemistry and Notes on Qualitative Analysis. CHARLES R. SANGER. St. Louis. 1896. Pp. 49.

Laboratory Experiments in General Chemistry. CHARLES R. SANGER. St. Louis. 1896. Pp. 59.